Model Answers

Summer – 2019 Examinations

Subject & Code: Switchgear & Protection (17508)

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Model Answers

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1 a) Attempt any THREE of the following: 12

1 a) i) List any eight essential features of effective protective system.

Ans:

Essential Features of Effective Protective System:

1) Selectivity
2) Speed
3) Sensitivity
4) Reliability / Trust worthiness.
5) Simplicity
6) Economical
7) Stability
8) Adequateness

1 Mark for any two features = 4 Marks

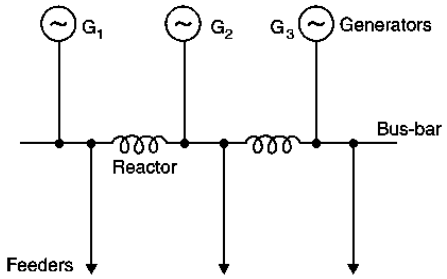
OR Equivalent Answer

1 a) ii) Draw diagram of

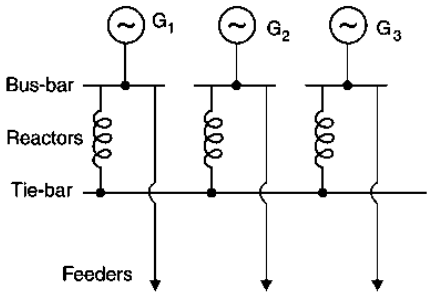
1) Busbar reactor
2) Generator reactor
3) Feeder reactor

Ans:

1)Bus Bar Reactor:



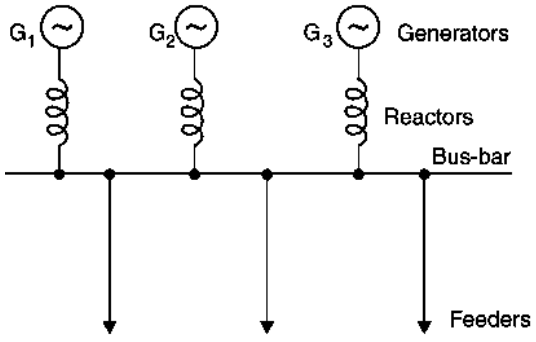
Ring system



Tie - Bar system

2 Marks

2)Generator Reactor:



1 Mark

3)Feeder Reactor:

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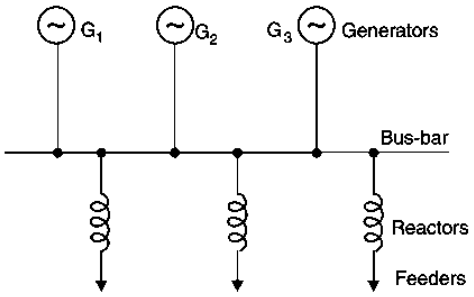

1 Mark

1 a) iii) Define TSM and PSM in relays.

Ans:

Time Setting Multiplier (TSM):

The arrangement provided for setting the operating time of protective relay from zero sec to maximum permissible time for a specified current setting is known as time setting multiplier.

Plug Setting Multiplier (PSM):

It is the ratio of fault current in relay coil to pick-up current.

PSM = (Fault current in relay coil) / (Pickup current)

2 Marks for each definition = 4 Marks

1 a) iv) Name internal and external causes of system over-voltages.

Ans:

Internal Causes of System Over-voltages :

1) Switching surges
2) Arcing ground
3) Insulation failures
4) Resonance

External Causes of System Over-voltages:

1) Direct Lightning strokes
2) Lightning discharge near the line
3) Voltage induced due to change in atmospheric condition
4) Voltage induced due to frictional effects of small particles such as dirt, dust, snow etc.

2 Marks for 2 internal causes and 2 Marks for 2 external causes = 4 Marks

1 b) Attempt any ONE of the following: 06

1 b) i) Fig. No. 1 shows single line diagram of three phase system.The percentage reactance of each alternator is based on its own capacity. Find short circuit current that will flow into a complete three phase short circuit at 'A' 'F'.

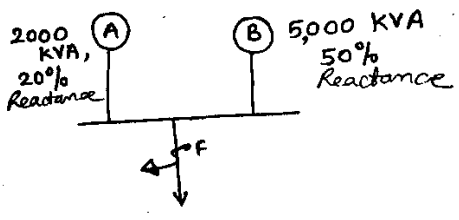

Fig. No. 1

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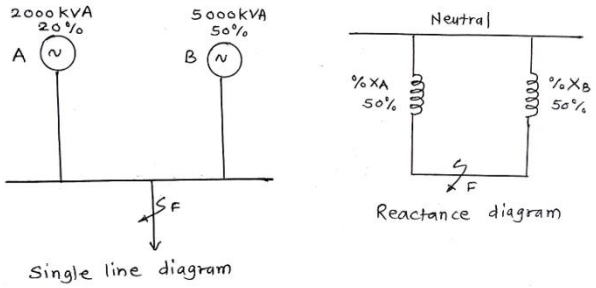
Ans:



1 Mark

(NOTE: Since data regarding line voltage is not specified, Examiners are requested to award the marks appropriately to the examinee who has attempted to solve the problem. Here the line voltage is assumed as 11 kV and point 'A' is not specified so fault at F is considered for the calculation of reactance as per assumed base kVA)

Now assume base kVA = 5000 kVA

% Reactance related to base kVA

% X = (Base kVA / Rated kVA) x % Reactance on Rated kVA

X_A = (5000/2000) x 10%
= 50 %

1 Mark

X_B = (5000/5000) x 50%
= 50 %

1 Mark

For Fault at Bus

Total reactance **,**

% X = X_A || X_B
= 50 || 50

1 Mark

% X = 25%

Rated current at base kVA = I = (5000 x 1000) / (√3 x 11 x 1000)
I = 262.431 amp

1 Mark

I_{SC} = I x (100/% X) = 262.431 x (100/25)

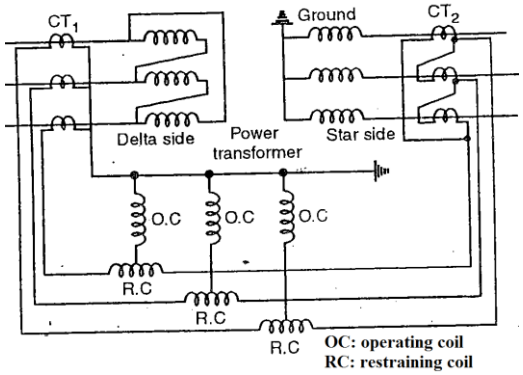
I_{SC} = 1049.724amp

1 Mark

1 b) ii) Draw the circuit diagram of biased differential protection of Δ/λ transformer.

Ans:

Biased Differential Protection of Δ/λ Transformer:



Labeled diagram 6 Marks

Partially Labeled diagram 4 Marks

Un-Labeled diagram 3 Marks

OR Equivalent Diagram

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2 Attempt any FOUR of the following: 16

2 a) Define:
i) Arcing time
ii) Recovery time
iii) Arcing voltage
iv) Rate of rise of restriking voltage

Ans:

i) Arcing time: It is the time measured from the instant of occurrence of cut off (or commencement of arc) to the instant at which arc is extinguished.

ii) Recovery time: The time required for piece of equipment to resume its usual condition following an action, such as the passage of a current through electrical equipment.

iii) Arcing Voltage: The voltage existing between the circuit breaker contacts during arcing is called as the arc voltage.

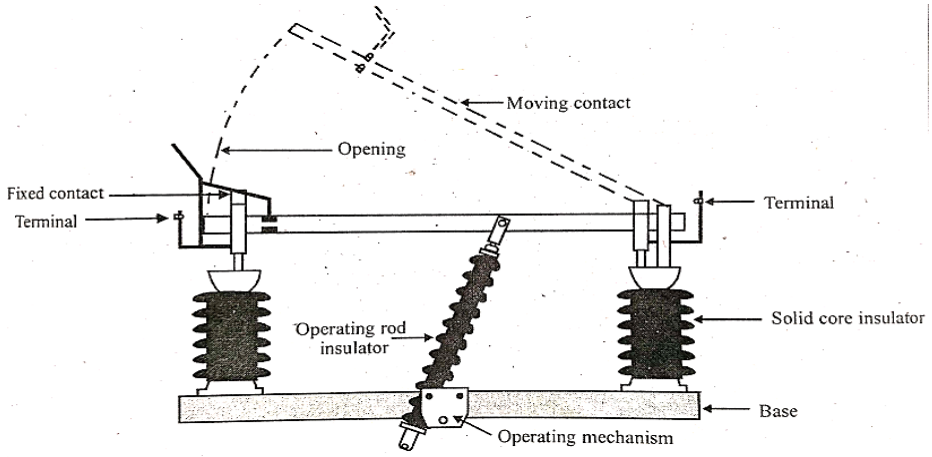
iv) Rate of Rise of Restriking Voltage: The RRRV (**R**ate of **R**ise of the **R**estriking **V**oltage) is defined as the slope of the steepest tangent to the restriking voltage curve. It is expressed in volts per micro-second.

1 Mark for each definition = 4 Marks

2 b) Draw a neat labeled constructional diagram of vertical type break isolator.

Ans:

Vertical Type Break Isolator.



Labeled diagram 4 Marks

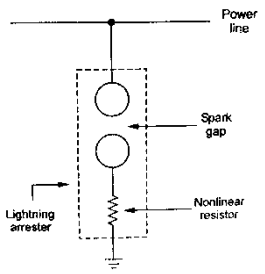
Partially Labeled diagram 3 Marks

Un-Labeled diagram 2 Marks

2 c) Explain basic principle of lightning arrestor and enlist different types of lightning.

Ans:

Basic Principle of Lightning Arrestor:



1 Mark for Diagram

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Lightning arrestor (LA) consists of spark gap in series with a nonlinear resistor. The line/equipment to be protected is connected to one end of LA and other end of LA is solidly grounded to earth. The length of spark gap is set such that normal working voltage is not sufficient to break the gap. The nonlinear resistor provides very high resistance for working voltage and offers very low resistance for high voltages.
Under normal working condition the gap does not break and nonlinear resistor offer very high resistance so there is no path for current from line to ground. But when lightning stroke/surge appears on the line/equipment then the spark gap breaks with the nonlinear resistor offering very low resistance value. Thus ultimately the lightning stroke is diverted to earth instead of entering the equipment and the equipment is protected.

2 Marks for Explanation

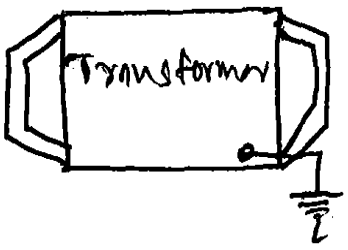
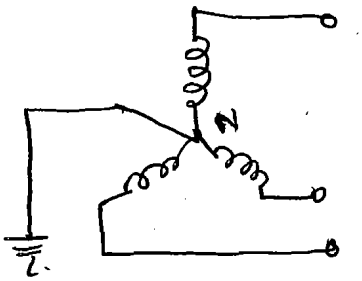
Types of lighting:
1) Direct Lightning Stroke
2) Indirect Lightning Stroke

1 Mark for types

2 d) Give any four differences between equipment earthing and neutral earthing.

Ans:

Difference between Equipment Earthing and Neutral Earthing:

Sr. No.	Equipment Earthing	Neutral Earthing
1		
2	When the noncurrent carrying metallic parts of the electrical equipment are connected to earth through a very low resistive path, it is called as equipment earthing.	When neutral of three phase star connected windings of transformers, generators, motors is connected to earth, it is called as neutral earthing.
3	It provides protection to living beings (animals/humans) against electric shocks.	Provides elimination of arching grounds and over voltage surges.
4	Does affect stability of the power system in any way.	Stability of the power system is increased.
5	Equipment earthing is provided through Pipe earthing, Plate earthing or earth mats etc.	Neutral earthing is provided through solid earthing, Resistance earthing, reactance earthing.
6	It provides protection to the living beings and also can help protective system to protect the system equipment against earth faults.	It provides suitable means for earth fault protection of equipment.

1 Mark for each of any four points = 4 Marks

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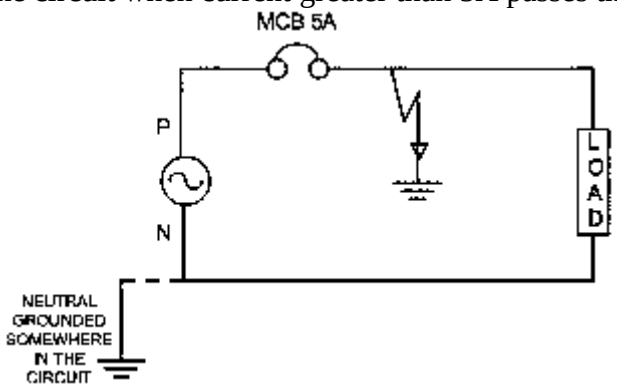
2 e) Whether MCB is operated for earth fault? Give reason

Ans:

MCB may or may not operate on earth fault here is the explanation:

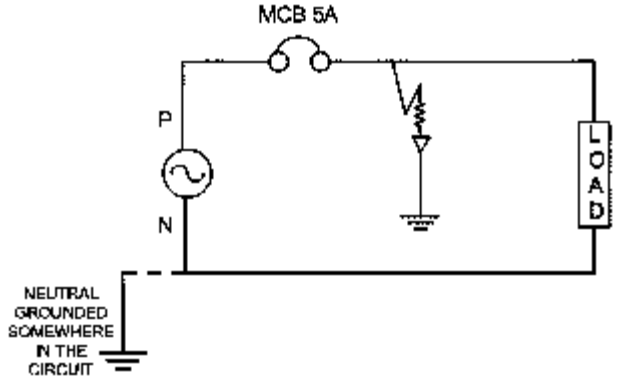
i) MCB is protective device that is made to break the circuit in case of overload or short-circuit. For Overload protection, it has bi-metallic strip which heats up during overload. The heating causes uneven expansion of bi-metals leading to bending of the strip. This bending movement is used to release the spring to trip or open the circuit. For short-circuit protection, an electromagnet is used, which produces strong magnetic field during short-circuit condition and attracts the magnetic plunger. The movement of plunger is used to release the spring to trip or open the circuit.

ii) MCB will work only in case when the current through it exceeds its rating. i.e a 5A MCB will trip the circuit when current greater than 5A passes through it.



4 Marks

Consider the above circuit in which the current flowing through MCB is sum of load current and fault current. If fault path resistance is less, the current flowing through the MCB may exceeds the limit i.e rated value of 5 A and the MCB will trip.



Consider a second case where the earth fault is through highly resistive path. So the fault current may be very less and total current flowing through MCB will be within the limit. Hence, even under earth fault condition, the MCB will not trip.

2 f) List the difficulties experienced in differential relay in alternator protection. How are they overcome?

Ans:

Difficulties Experienced in Differential Relay in Alternator Protection:

Sr. No.	Difficulties Experienced in Differential Relay in Alternator Protection:	How are they overcome?
1	The differential protection provides very fast protection against phase to phase faults and phase to ground faults. If neutral is not grounded or grounded through resistance, error may cause.	Additional sensitive earth fault relay should be provided.
2	When differential relay is used for protection, the CT's should be identical in design, otherwise the ratio error may occur.	Use Biased Differential protection.
3	There may be unequal length of leads of CT wire connections, causing error.	Use Biased Differential protection
4	Unequal secondary burden on CT.	Use Biased Differential protection

1 Mark for each of any four points = 4 Marks

OR Equivalent Answer

3 Attempt any FOUR of the following: 16

3 a) Explain arcing phenomenon in circuit breaker.

Ans:

Arcing Phenomenon in Circuit Breaker:

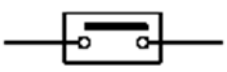
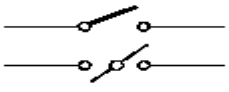
When a fault occurs, a large current flows in a system and hence through circuit breaker connected in circuit. The circuit breaker is opened by protective system. At the instant when contacts just begin to separate, the face-to-face contact area between contacts reduces rapidly and the large fault current gets concentrated on reduced contact area. This causes very large current density at reduced contact area, which in turn rises temperature of contacts. With further movement of contact, the area again reduces, giving higher current densities and higher temperature rise. The heat produced due to very high temperature heats the surrounding medium and ionizes the medium. This ionized medium act as a conductor and establishes the current through separated contacts. This current through media due to ionization is called arc.

4 Marks

3 b) Distinguish between circuit breaker and isolator.

Ans:

Difference Between Circuit Breaker and Isolator:

Sr. No.	Circuit breaker	Isolator
1	Symbol 	Symbol 

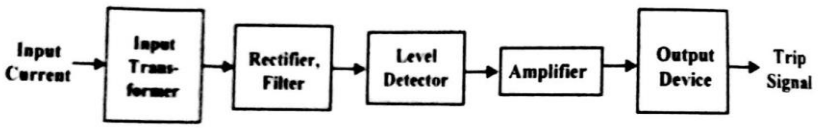
2	Operated ON load /on occurrence of fault.	Operated on NO load.
3	Heavy current is interrupted, arc is produced hence arc quenching facility is provided.	No arcing during ON/OFF, so no arc quenching facility provision.
4	Operation is in oil or gas chamber (not visible).	Visible operation in open air (opening & closing of contacts).
5	Big sound on operation.	Noise-less operation.
6	Costly / Expensive.	Economical
7	Periodic maintenance is very much required.	No periodic maintenance required (only contact cleaning).
8	Occupy more space.	Occupy less space.
9	Requires tripping circuit for operation.	No tripping circuit.
10	Manually operated in normal condition & automatically operated in fault condition.	Operation may be manual/mechanical/pneumatic.
11	Types are as follows: (a) Air break C. B. (b) Oil C.B. (c) Air blast C.B. (d) Vacuum C.B. (e) SF6 C.B. (f) MCCB etc.	Types are as follows: (a) Vertical break type (b) Horizontal break type (c) Pantograph type etc.
12	Complicated in construction.	Simple in construction.

1 Mark for each of any four points = 4 Marks

3 c) With a neat diagram explain the working of static over current relay.

Ans:

Static Over Current Relay:



Block diagram of static over current relay

2 Marks for diagram

The current derived from the main CT is feed to the input transformer, which gives a proportional output voltage. The input transformer has an air gap in the iron core to give linearity in the current voltage relationship up to the highest value of current expected and is provided with taping on its secondary to obtain different current settings. The output voltage is then rectified and then filtered at a single stage to avoid undesirable time delay in filtering so as to excurse high speed of operation. A zener diode is also incorporated in the circuit to limit the rectified voltage to safe value even when the input current is very high under fault conditions.

A fixed portion of the rectified filtered voltage is compared against a preset pick-up value by a level detector and if it exceeds the pick-up value, a signal through an amplifier is given to the output device, which issues the trip signal.

2 Marks for Explanation

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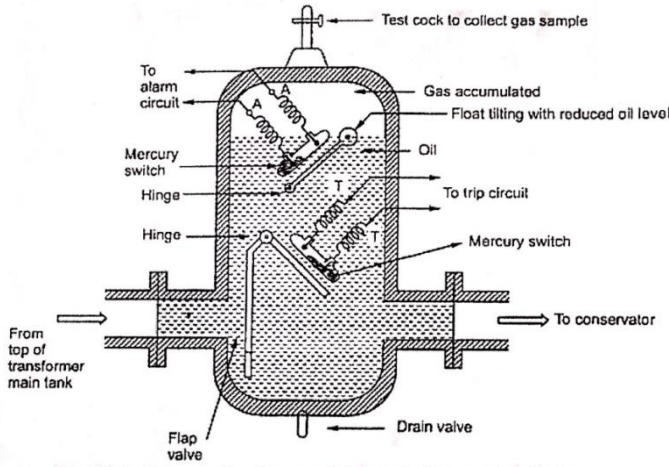
3 d) Describe the opeartion of Buchholz relay with principle and installation.

Ans:

Opeartion of Buchholz Relay with Principle and Installation :



Terminals 'A' : are for alarm and Terminals 'T': are for tripping.

Buchholz relay

2 Marks for Diagram

The relay is located in the path of the oil from transformer tank to conservator. As seen from diagram, the upper mercury switch operates the alarm circuit due to tilting of the float by accumulation of gas evolved slowly in the transformer tank due to minor faults, which may develop into major ones if the alarm is not investigated.

Further lower mercury switch operates the trip circuit to switch off the circuit breaker related to the transformer when there is a sudden flow or rush of oil from the transformer tank to conservator. Such flow occurs when there is serious fault in the transformer tank. Here the float (lower) is placed in such a manner that it senses the sudden violent movement of oil from transformer tank to conservator.

2 Marks for Description

3 e) A 3 phase transformer of 220 V/11 kV line volts is connected in λ/Δ.The protective transformer on 220 V side have current ratio of 600/5.What should be the CT ratio on 11 KV side?

Ans:

1) Line current on 220 V side is 600 amp
   Phase current on delta connected CT's on 220 V side = 5 amp
2) Line current of delta connected CT's on 220 V side = $5\sqrt{3}$ amp
   $= 8.66$ amp. — 1 Mark
   This current of 8.66 amp will flow through the pilot wires, obviously this will be the current which flows through the secondary of CTs on the 11kV side.
3) Phase current of star connected CT on 11 kV side $= 5\sqrt{3}$ amp $= 8.66$ amp — 1 Mark
   If I_2 is the line current on 11kV side, then
4) For transformer,
   $\sqrt{3}\ V_1\ I_1 = \sqrt{3}\ V_2\ I_2$
   $\sqrt{3} \times 220 \times 600 = \sqrt{3} \times 11000 \times I_2$
   $I_2 = (\sqrt{3} \times 220 \times 600) / (\sqrt{3} \times 11000)$
   $I_2 = 12$ amp — 1 Mark

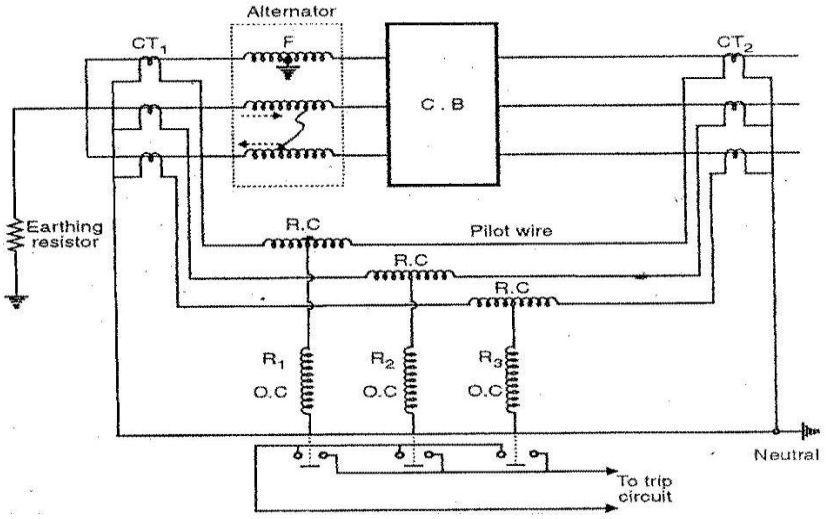
Therefore CT's ratio on 11000 V side = 12 : 8.66 — 1 Mark

4 a) **Attempt any THREE of the following:** **12**

4 a) i) Draw a neat labeled diagram of Merz Price protection scheme for an alternator.

Ans:

Merz Price Protection of Alternator:



Labeled diagram 4 Marks

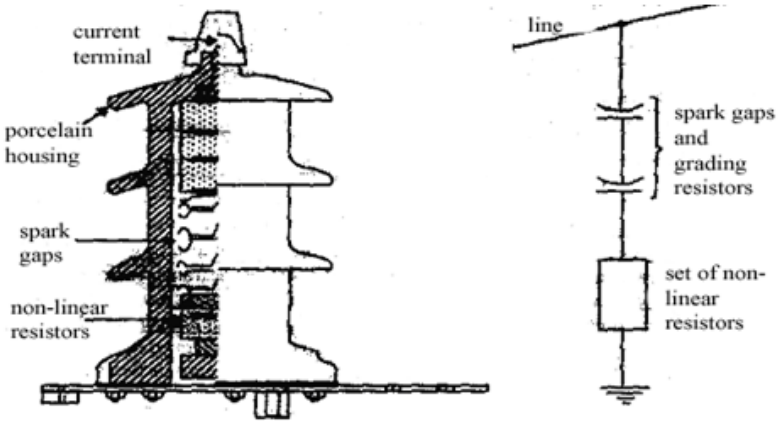
Partially Labeled diagram 3 Marks

Un-Labeled diagram 2 Marks

4 a) ii) With neat sketch explain Thyrite type Lighting Arrestor.

Ans:

Thyrite Type Lightning Arrestor :



2 Marks for Diagram

When the line voltage is normal, the air gap assembly does not break down. When a lighting stroke occurs the series spark gap breaks down providing the earth path for the surge current through the nonlinear resistors, which offer a low resistance to surge current and again regain back high value after the surge gets conducted to earth.

2 Marks for Explanation

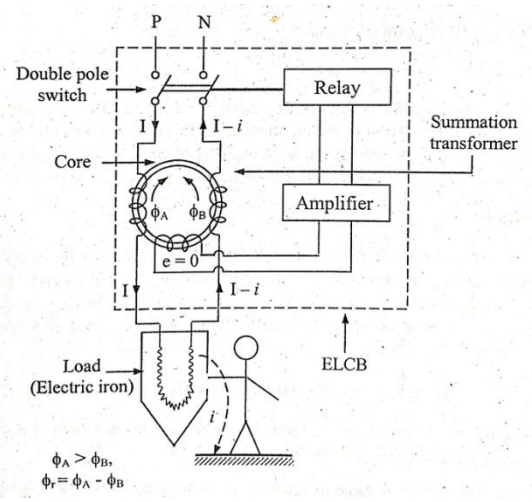
4 a) iii) "ELCB is must for a residential installation". Justify the statement.

Ans:

ELCB is must for a Residential Installation:

When the insulation of equipment fails and person touches the metal casing, the leakage current (say i) flows through human body and he may receive severe shock. However, if ELCB is used with residential installation, it senses the fault current (leakage current) and operates in very short time under such conditions and the current flowing through the body of person/operator is interrupted. Thus the person is protected from getting electric shock. 2 Marks for Explanation

Referring to the figure, under normal condition, the phase current I flows through circuit and same amount of current I returns through circuit hence relay does not operate. But when fault occurs, a small part of I say i completes its path through fault, human being and earth. The return current through neutral gets reduced to (I - i). Therefore, flux ϕ_B reduces to a value less than the flux ϕ_A. Hence the resultant flux Φ_r $=(\phi_A - \phi_B)$ induces an emf, which is further amplified and operates relay circuit within 50ms, resulting into opening of the mains and ultimately protects the person / operator because of ELCB. So it is must for a residential installation.



2 Marks for Diagram

OR Equivalent Answer

4 a) iv) Explain time graded over current protection for ring main system of busbar.

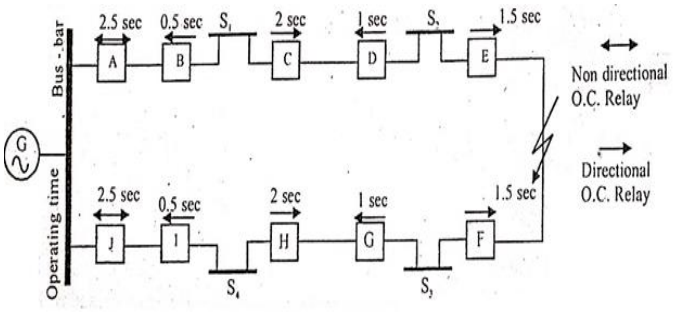
Ans:

Time Graded Over Current Protection for Ring Main System of Bus Bar:

The ring main consists of various generating stations and substations interconnected by alternate routes. When the fault occurs in any section of the ring, that section can be disconnected for repairs and power is supplied from both ends of ring, maintaining the continuity of supply. 2 Mark for Explanation

Figure represents the single line diagram of a typical ring main system, which consists of a generator and four sub-stations S_1, S_2, S_3, S_4. As the power can flow in both the directions under fault conditions, it is necessary to grade feeder protection in both directions round the ring with directional relays.

In order to ensure selectivity, the circuit breakers at E & F should open to clear the



2 Marks for diagram

fault, there by maintaining other section intact. Actually the power is fed to the fault via two routes i.e. (i) From G around S_1, S_2 and (ii) from G around S_4 and S_3. The relays at A, B, C and D as well as J, I, H and G do not trip. Therefore, only relays at E and F operate before any other relay operates.

4 b) **Attempt any ONE of the following:** **06**

4 b) i) Explain what is single phasing of 3ϕ I.M? Draw a neat circuit diagram of single phase preventer.

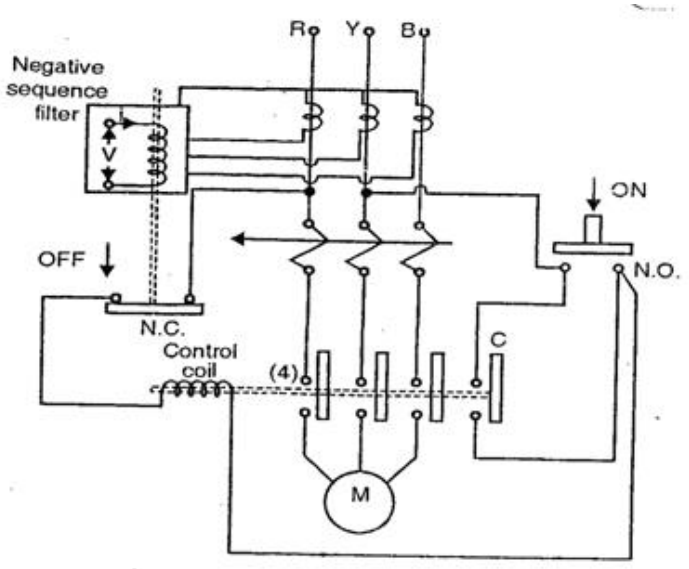
Ans:

Single Phasing of 3ϕ I.M :

When one of the supply lines of the three phase supply connection gets disconnected then this situation is known as single phasing. Under this condition, motor continues to operate on two-phase supply. If the motor is loaded to its rated full load, it will draw excessive current on single phasing. Single phasing may cause extreme magnetic unbalance, reduction in torque and over- heating due to negative phase sequence current. This condition may cause damage to the motor. Hence protection against single phasing is necessary.

3 Marks

Single Phase Preventer:



3 Marks

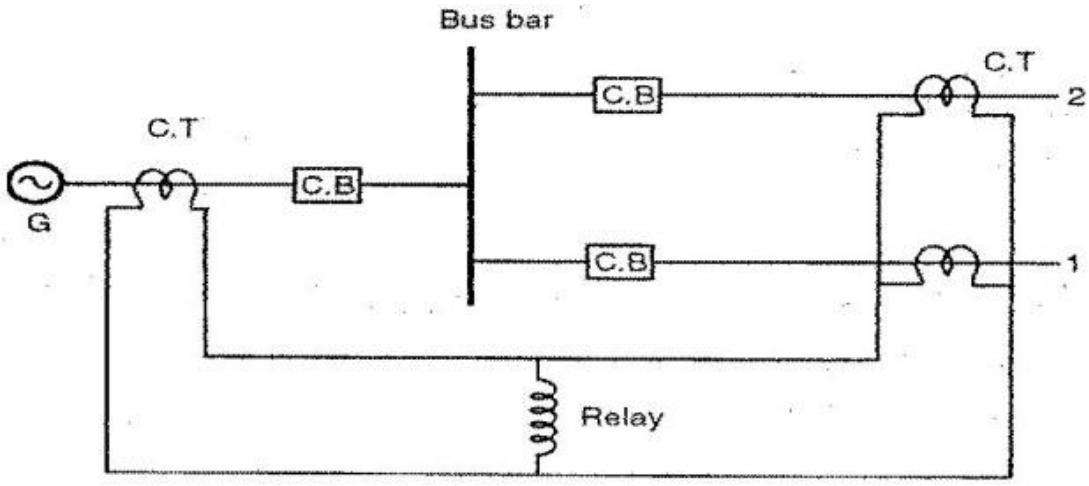
4 b) ii) Explain differential protection for busbar with diagram.

Ans:

Differential Protection for Busbar:

Under normal conditions, the sum of the currents entering the bus bar zone is equal to those leaving it and no current flows through the relay coil. If a fault occurs within the protected zone, the currents entering the bus will no longer be equal those leaving it. The difference of these currents will flow through the relay coil causing opening of circuit breaker.

3 Marks for Explanation



Differential protection of bus bar

3 Marks for Diagram

5 Attempt any FOUR of the following: 16

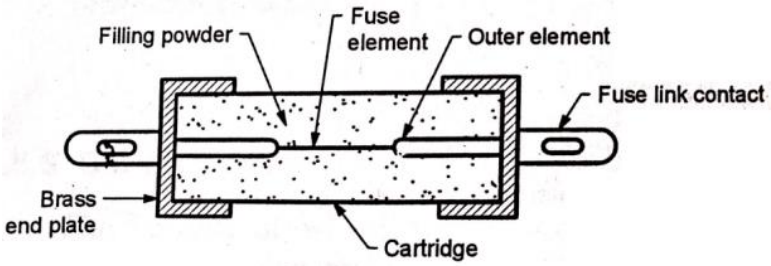
5 a) Explain construction and working of HRC fuse with diagram.

Ans:

Construction of HRC fuse:

HRC fuse mainly consists of heat resisting ceramic body. The current carrying element is compactly surrounded by the filling powder. Filling material acts as an arc quenching and cooling medium when the fuse element blows off due to excessive heat generated under abnormal conditions.

1 Mark for Construction



H.R.C. fuse

2 Marks for Diagram

Working:

Under normal conditions, the fuse element is at a temperature below its melting point. Therefore, it carries the normal current without overheating.

When a fault occurs, the current increases and the heat produced is sufficient to melt

1 Mark for Working

these elements. Fuse element melts before the fault current reaches its first peak value. Vaporized metal /fuse element chemically reacts with filling powder and results in the formation of high resistance substance that helps in quenching the arc.

5 b) State methods for arc extinction and explain working of any one method with neat circuit diagram.

Ans:

Methods for Arc Extinction:

There are two methods of arc extinction:

1 Mark for two methods

i) High resistance extinction method
ii) Low resistance or Zero current extinction method

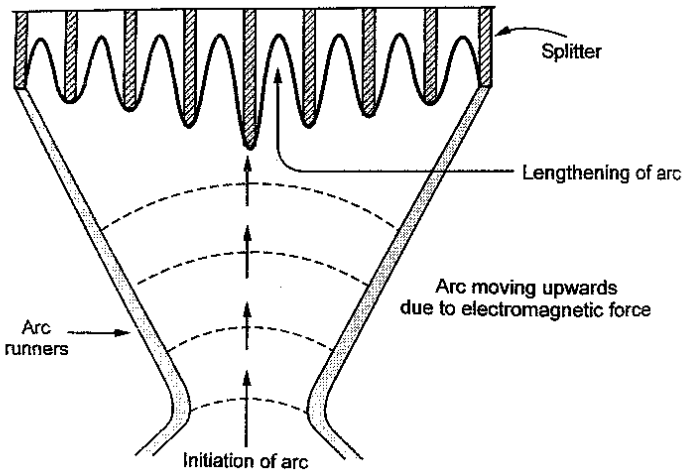
High Resistance Arc Extinction Method:

In this method, the arc is so controlled that its effective resistance increases with time so that the current reduces to a value insufficient to maintain the arc. The currents tends to be in phase with the voltage so that at zero current instant, the restriking voltage appearing across the contacts is relatively low and arc cannot struck again. Arc path resistance is increased to reduce the current to low values while interrupting the arc.

Arc resistance = v_{arc}/i_{arc}. The arc resistance mainly increased by:

3 Marks for Explanation with Diagram of any one method

i) Lengthening of the arc by arc runners
ii) Splitting the arc by arc splitters: An appreciable voltage is absorbed at the contact surface so that if the arc can be split into a number of small arcs in series, the voltage available for the actual arc column is reduced.
iii) Arc cooling: The voltage required to maintain ionization increases with decrease of temperature of arc, so that cooling effectively increases the resistance.
iv) Constraining the arc: If the arc can be constrained into a very narrow channel, the voltage necessary to maintain it is increased.

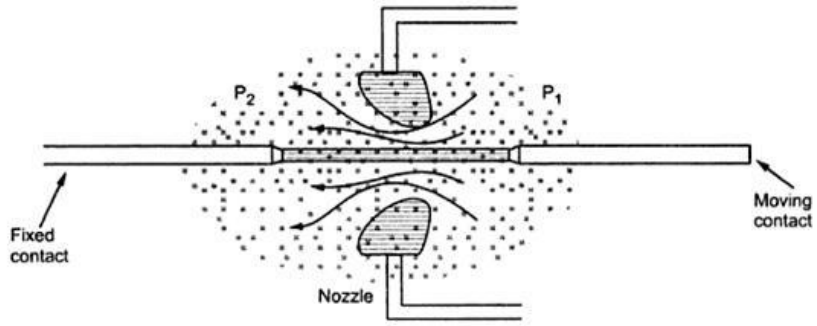


Arc Extinction Method by Lengthening, Splitting and Cooling the Arc
OR Equivalent Diagram and Answer

Current Zero or Low Resistance Method:

This method is employed in a.c. circuit breakers, since the ac passes through zero 100 times/second in 50 cycle current wave. When current wave passes through every zero,

the arc vanishes for a brief moment. However the arc restrikes again with the rising current waves.
In this method, at current zero instant, fresh unionized medium is introduced between the spaces in between the contacts. Due to this medium deionization effect takes place. The dielectric strength of the contact space increases to such an extent that the arc does not continue after current zero.



OR Equivalent Diagram and Answer

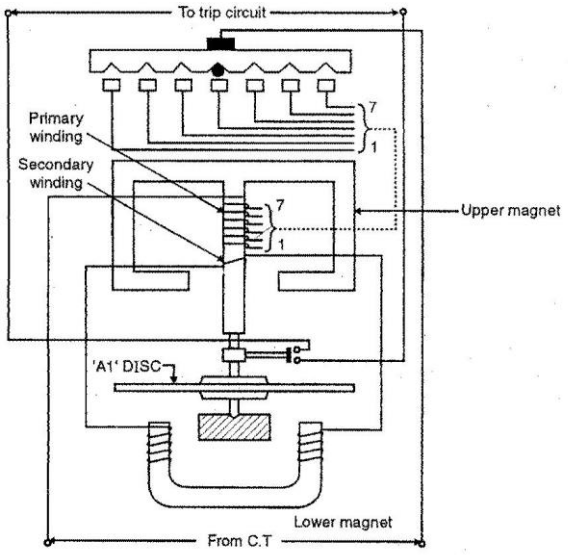
5 c) With the help of neat sketch, explain principle of operation and working of induction type overcurrent relay.

Ans:

Principle of Operation and Working of Induction Type Overcurrent Relay:

Figure represents the details of induction type overcurrent relay. It consists of two electromagnets, the upper magnet is of 'E' shape & on the central limb of which are placed two windings. The upper winding acts as primary winding and lower winding acts as secondary winding. The upper magnet produces flux ϕ_1 when current flows through primary winding. The alternating flux ϕ_1 of primary winding links to secondary winding ultimately induces emf in the secondary winding. The emf induced in the lower winding produces current to flow through the winding placed on the lower 'U' magnet. This secondary current produces flux ϕ_2. The two fluxes ϕ_1 and ϕ_2 are sufficiently displaced from each other and cause eddy currents in the disc, which will set up a torque on the disc causing rotation of the disc. The tapings are connected to plug setting bridge for giving desired current setting.

2 Marks for Explanation



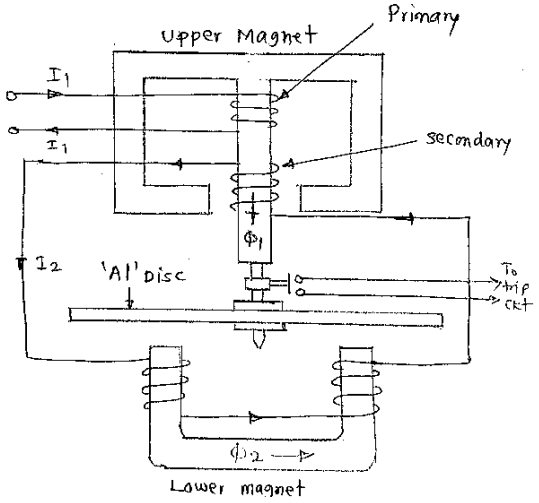
Induction type over current relay (non – directional)

2 Marks for Diagram

5 d) With neat sketch, explain watt-hr-meter structure of induction type relay.

Ans:

Watt-Hour Meter Structure of Induction Type Relay:



2 Marks for Diagram

The general arrengement of watt-hour-meter structure of induction type relay is shown in figure. It consists of a pivoted aluminum disc arranged to rotate between the poles of two electromagnets. The upper electromagnet carries two windings, the primary and the secondary.

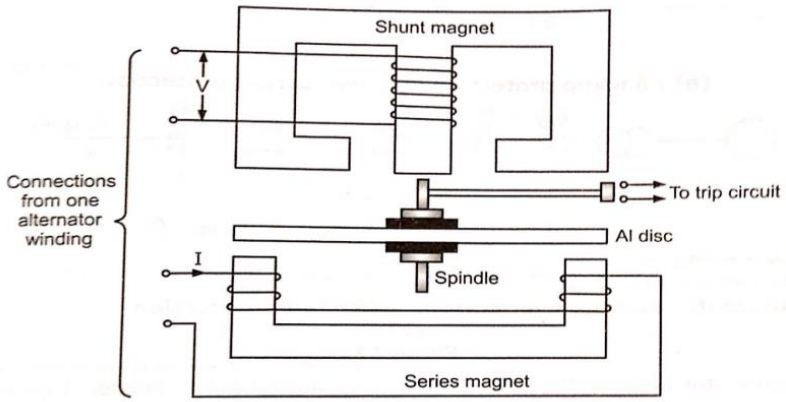
The primary winding carries the relay current I_1 while the secondary winding is connected to the winding of the lower magnet. The primary current induces emf in the secondary and so circulates a current I_2 in it. The flux ϕ_2 induced in the lower magnet by the current in the secondary winding will lag behind ϕ_1 by an angle α. The two fluxes ϕ_1 and ϕ_2 differing in phase by α will produce a driving torque on the disc proportional to $\phi_1 \phi_2 \sin \alpha$.

2 Marks for Explanation

5 e) Draw neat sketch of induction type reverse power relay and explain its working.

Ans:

Induction Type Reverse Power Relay:



2 Marks for Diagram

Figure shows the induction type directional relay used for the reverse power protection. Here the shunt magnet coil and series magnet coil are exited from machine

to whom protection is to be provided (e.g. Alternator). When power flow direction is correct, the disc rotates in the normal direction and does not close trip contacts. But when the power flow reverses, the disc rotates in opposite direction causing closure of trip contacts. — 2 Marks for Explanation

5 f) Compare electromechanical relay and static relay.

Ans:

Comparison between Electromechanical Relay and Static Relay.

Sr. No.	**Electromechanical Relay**	**Static Relay**
1	Its accuracy is very high.	Its accuracy is comparatively low.
2	Power consumption is high	Power consumption is low
3	There are moving parts in this relay.	There are no moving parts in this relay
4	Its operating time is comparatively high.	Its operating time is very small.
5	It needs more space.	These are compact hence need less space.
6	Remote backup and monitoring is not possible.	Remote backup and monitoring is possible.
7	Its operation can be affected by vibrations and shocks.	Its operation cannot be affected by vibrations and shocks.
8	It is not affected by temperature changes.	It is very much affected by temperature changes.
9	Construction is robust.	Construction is delicate.
10	These are affected by gravity.	These are not affected by gravity
11	Lower torque / weight ratio	Higher torque / weight ratio
12	Auxiliary power supply is not needed.	Auxiliary power supply is needed.
13	Not affected by voltage transients.	Affected by voltage transients.
14	Cannot be programmed.	Can be programmed as per requirement.

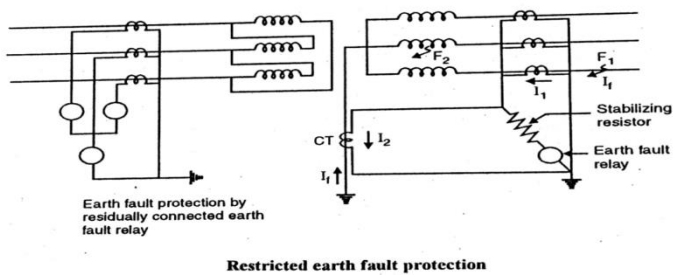
1 Mark for each of any four points = 4 Marks

6 Attempt any FOUR of the following: 16

6 a) Draw figure for restricted earth fault protection scheme for transformer.

Ans:

Restricted Earth Fault Protection Scheme for Transformer:



Restricted earth fault protection

Labeled diagram 4 Marks

Partially Labeled diagram 3 Marks

Un-Labeled diagram 2 Marks

Model Answers
Summer – 2019 Examinations
Subject & Code: Switchgear & Protection (17508)

6 b) Explain why the secondary of a CT should not be open circuited?

Ans:

Secondary of a CT should not be Open Circuited:

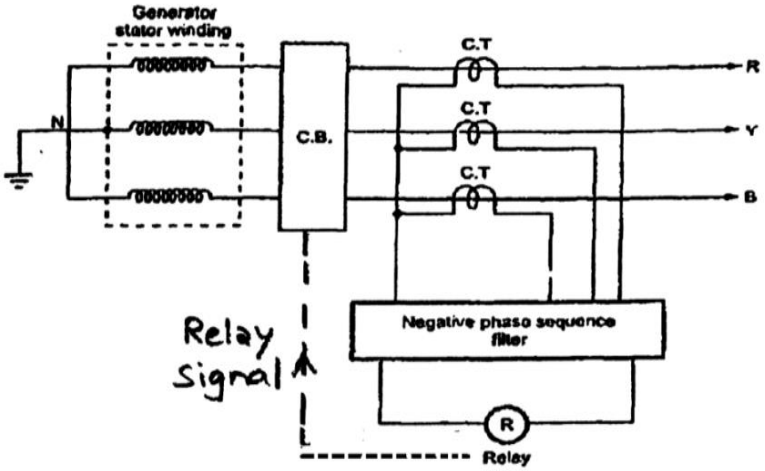
If secondary of CT is open circuited, then current through secondary becomes zero hence the ampere-turns produced by secondary which generally oppose primary ampere-turns becomes zero. As there is no counter m.m.f, the unopposed primary m.m.f (ampere-turns) produce very high flux in the core. This produces excessive core losses, heating the core beyond limits. Similarly heavy e.m.f's will be induced on the primary and secondary side. This may damage the insulation of the winding. This is danger from the opeartor point of view as well. So secondary of a CT should not be open circuited. — 4 Marks

6 c) Explain how negative sequence current are set up in an alternator?
Draw protective scheme for same.

Ans:

Negative Phase Sequence Protection:

Because of unbalance load, negative phase sequence currents are produced and they overheats alternator, the protection against this is provided by negative phase sequence current protection scheme. — 2 Marks for Explanation



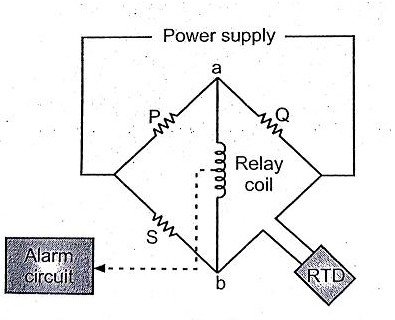
Negative sequence protection

2 Marks for Diagram

6 d) Explain over heating protection scheme of 3 phase transformer.

Ans:

Over Heating Protection Scheme of 3 Phase Transformer:



2 Marks for Diagram

Figure shows overheating protection scheme for 3 phase transformer. Wheatstone's bridge principle is used to detect overheating. P, Q and S are the fixed value resistances. The RTD is connected in one arm. This RTD is kept near each winding of transformer.

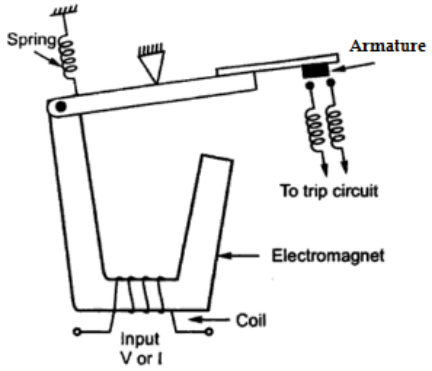
When temperature is within limits, points a and b are at same potential and relay coil does not carry any current i. e. bridge is balanced. When overheating occurs, RTD resistance changes causing imbalance and some potential difference is created across the points a and b. The relay coil is thus energized and relay operates the alarm circuit. — 2 Marks for Explanation

OR Any Equivalent Answer

6 e) Explain with neat sketch the operation of attracted armature type relay. State two advantages.

Ans:

Operation of Attracted Armature Type Relay:



Hinged attracted armature relay

1 Mark for Diagram

The coil is energized by the actuating quantity current or voltage proportional to the system voltage or current as the case may be. The electromagnetic force on the armature is proportional to the square of the magnetic flux (the flux is proportional to the current in the coil) in the air gap between core and armature. As the armature is attracted and its motion is linked to the trip contacts that operate to give the trip signal. The force of attraction increases as the armature nears the core (or as the air gap reduces). A restraining force in the form of a spring can be used to avoid unwanted operation of the armature relay for normal currents in the current coil. — 2 Marks for Operation

Advantages:

1. Simple construction.
2. Reliable operation.
3. Unaffected by temperature changes.
4. Long life.
5. Robust construction.

— 1 Mark for any 2 advantages